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EXPLANATORY NOTES

WOORAMEL, W.A.



Sheet SG/50—5

International Index

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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Compiled by M. A. Condon

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DEPARTMENT OF NATIONAL DEVELOPMENT

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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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Explanatory Notes on the Wooramel Geological Sheet

Compiled by M. A. Condon

The Wooramel Sheet is bounded by latitudes 25° and 26° South and longitudes 114° and 115° 30' East. The map is entirely the result of unpublished work of geologists of the Bureau of Mineral Resources and West Australian Petroleum Pty Ltd. It was compiled by the author, who is responsible for the interpretation presented in the map and section.

Previous Work

Very little work has been done, and less reported, on the Wooramel Sheet area.

The earliest work is that of Maitland, who discovered the Permian glacial sequence in 1900 and gave the name 'Lyons Conglomerate' (Maitland, 1912, p. 8) to an outcrop in the Arthur River and another in the Wyndham River, just beyond the north-eastern margin of the Wooramel Sheet. He also described what is now called Callytharra Formation in its outcrop in the Arthur River at the north-east corner of the Sheet. Maitland made a traverse along the telegraph line from Carnarvon to Northampton in 1901 (Maitland, 1907) ; he mentioned 'fossiliferous Tertiary rocks, and the Mesozoic beds' near the mouth of the Wooramel River.

Woolnough (1929, unpubl.), Talbot (1929, unpubl.), Feldtman (1930), and Hossfeld (1931, unpubl.) visited the Callytharra Spring area in the course of investigations of the oil prospects of the Byro Plains area to the east. Dee & Rudd (1932, unpubl.) reported on the Byro Plains area and determined the Permian sequence in that area. This work was first published by Condit (1935), who was in charge of the investigation, followed by Raggatt (1936), and Condit, Raggatt & Rudd (1936). Miss Crespin and Mr Chapman examined the fossils collected by these geologists and prepared several unpublished reports (1930, 1931, 1932, 1934a, b, c.). The stratigraphic importance of the fauna contained in the Callytharra Formation was recognized ; Raggatt & Fletcher (1937) used these palaeontological reports in establishing the Permian age of the strata from which they were collected. Hobson (1936) gave a summary of the sequence penetrated by water bores in the Shark Bay region.

L. M. Waterford examined the north-eastern part of the Sheet and the Callytharra Spring area for Freney Kimberley Oil Co. and produced, about 1937, a printed map of the area between Mount Sandiman and Byro showing fossil localities ; this was by far the best regional map and sections to that date, but it was not published. Crespin (1937, unpubl.) reported on Waterford's collection of fossils.

M. A. Condon, D. Johnstone, M. H. Johnstone, and P. E. Playford of the Bureau of Mineral Resources mapped the north-eastern part of the Sheet in 1953, and Condon and M. H. Johnstone visited the Callytharra area to measure the section of the Callytharra Formation in the type locality; they discovered the Carrandibby Formation. McWhae, Parry, and Stanley in 1953 carried out a reconnaissance survey of the Callytharra/Carey Downs area and discovered a glacial pavement in Nyarra Creek (McWhae, Parry, & Stanley, 1954 unpubl.). McWhae, Playford, Lindner, Glenister & Balme (1958) summarized the data then available.

A reconnaissance gravity survey of the Sheet area was completed by geophysicists of the Bureau of Mineral Resources in 1953 (Chamberlain, Dooley, & Vale, 1954). Aeromagnetic surveys were carried out by the Bureau of Mineral Resources in 1956 over the northern part and in 1960 over the southern part (B.M.R. G.G., 1963).

Konecki, Dickins, & Quinlan (1958) described the geology of the southern part of the Sheet; they included information obtained by Johnstone & Playford (1955 unpubl.) for West Australian Petroleum Pty Ltd.

Fossils collected in the Sheet area have been described by Hosking (1931, 1932, 1933), Prendergast (1933, 1944), Teichert (1949), Crockford (1944), Coleman (1957), Dickins (1957, 1963), Crespin (1958), Thomas (1958), and Crespin & Belford (1959).

PHYSIOGRAPHY

The Wooramel Sheet area is almost entirely a plain, sloping very gently westward towards Shark Bay, which is part of the Tertiary land-surface and is underlain by lateritic rocks. The Wooramel River crosses it in the south; the river appears to follow its Tertiary course, since the lateritic surface slopes down towards its present valley, but it is somewhat entrenched. The plain originated probably by marine erosion and deposition in the Eocene; traces of the consequent drainage system of a true coastal plain are evident on the plain surface in the west. There is a Pleistocene to Recent delta near the mouth of the Wooramel River, and a narrow Pleistocene coastal plain borders Shark Bay. In the north-east the Tertiary land surface has been dissected and an outcrop plain with few strike ridges has been developed; the Gascoyne River flows through this part of the Sheet.

The north central part is occupied by aeolian sand that forms seif dunes, generally trending east-west in the eastern part and swinging to north-south in the western part. The red sand of the dunes was derived from the upper part of the lateritic profile and was moved into dunes during arid periods of the Pleistocene.

STRATIGRAPHY

The oldest rocks exposed are the Precambrian schists that crop out near the eastern margin, between Nyarra Creek and Wooramel River. Rock types include quartz schist, mica schist, and minor hornblende schist, talc schist, and micro-gneiss. There is no direct evidence of the age of these metamorphic rocks except that they are unconformably overlain by Permian sediments; they are assumed to be of Precambrian age because of their lithological similarity to the widespread schist to the east of the Carnarvon Basin. The schists are intruded by acid and basic dykes.

Rocks similar to the schist of this outcrop may form the basement under much of the Wooramel Sheet, but the possibility may be inferred from the gravity anomaly over the western part of the Sheet (Chamberlain, Dooley, & Vale, 1954) that the basement of that part is a denser rock, perhaps more like the garnetiferous granulitic gneiss of the Ajana-Northampton Inlier (Prider, 1958).

PRE-PERMIAN

Although no pre-Permian sedimentary rocks are known in outcrop or in bores in the Sheet area they probably occur below the surface. There is no reason to infer the presence of rocks equivalent to the Badgeradda Group (Perry & Dickins, 1960), but it is quite likely that equivalents of the Tumblagooda Sandstone (Clarke & Teichert, 1948) of probably lower Palaeozoic age (Öpik, in McWhae et al. 1958, p. 17) extend into this Sheet. Silurian dolomite and limestone discovered in the West Australian Petroleum Company's Dirk Hartog No. 17B Bore may extend into the Sheet area. Recent seismic refraction surveys by the Bureau of Mineral Resources south of Shark Bay (Bow & Turpie, 1964) indicate that those carbonates extend eastward to about 114° 45' East longitude. The Devonian rocks penetrated in the Pelican Hill Bore (10 miles north of Carnarvon) (Thomas & Dickins, 1954) almost certainly extend into the Sheet area. Beyond these inferences, nothing is known about the occurrence or distribution of pre-Permian sedimentary rocks in the Wooramel Sheet area.

PERMIAN

The Sakmarian *Lyons Group* (Maitland, 1912; Raggatt, 1936; Condon, 1954, 1961) crops out between Nyarra Creek and Wooramel River, along the Wooramel River upstream from Seven-Mile Pool, possibly in deeply weathered (lateritized or duricrusted) outcrop along the Wooramel River between Seven-Mile and Meedo Pools, between Pells Creek and Winderie Homestead, and on either side of the Gascoyne River 10 miles west of Jimba Jimba Homestead. The sequences on the Wooramel and Gascoyne Rivers are not assigned to a formation. Two small outcrops of tillitic quartzwacke resting on Precambrian schist in Nyarra Creek, 9 miles south of Carey Downs Homestead, have been tentatively identified as *Koomberan Greywacke* (Condon, 1962). The *Mundarie Siltstone* (Condon, 1960) is exposed in a very small area in the

north-east corner ; the rock is a tillitic siltstone. It is overlain by the Thambrong Formation. The *Thambrong Formation* (Condon, 1960) crops out only in small areas south of Pells Range and in the north-eastern corner, where it consists of quartzwacke and tillitic siltstone. In both places it is unconformably overlain by the Callytharra Formation.

The sequence east from Winderie is part of the *Weedarra Shale* (Condon, 1962a). The main lithology exposed is tillitic siltstone ; the sandstone member crops out two miles south-east of Winderie and marine fossils are found at two localities $\frac{1}{2}$ mile south-east of that homestead (Waterford discovered this locality about 1937). Poor exposure makes thickness determination doubtful, but there may be about 1500 feet of the Weedarra Shale. In this area there is a well-developed angular unconformity between the Weedarra Shale and the Callytharra Formation. Between Nyarra Creek and Wooramel River the Lyons Group consists of tillitic siltstone and quartzwacke with boulder beds, unconformably onlapping the Precambrian schist. Here it is overlain unconformably by Carrandibby Formation, Nunnery Sandstone, and One Gum Formation.

The Sakmarian or, more probably, Artinskian *Carrandibby Formation* (Konecki, Condon, Dickins, & Quinlan, 1958) crops out in its type locality on the south side of the Wooramel River, three miles upstream from Seven-Mile Pool, where it is 193 feet thick. It has not been recognized in the Winderie area between the Callytharra Formation and the Lyons Group. The Artinskian *Callytharra Formation* (Condit, 1935 ; Condon, 1954) crops out in the Winnemia ridge, 10 miles west of Jimba Jimba Homestead, where it lenses out from about 200 feet thick ; in Pells Range (175 feet) ; east of Winderie (about 100 feet) ; and in its type locality four miles upstream from Seven-Mile Pool on the Wooramel River, where it is 330 feet thick. The Callytharra Formation consists of richly fossiliferous calcarenite, calcilutite, and siltstone, and is the most distinctive formation of the Permian sequence of the Carnarvon Basin. It is unconformable on the Lyons Group, perhaps disconformable on the Carrandibby Formation, and is unconformably overlain by the Wooramel Group.

The Artinskian *Wooramel Group* (Condit, 1935 ; McWhae et al., 1958, p. 61 ; Konecki, Dickins, & Quinlan, 1958 ; Condon, 1962b) includes in outcrop on this Sheet the Nunnery Sandstone, One Gum Formation, Keogh Formation, Moogooloo Sandstone, Jimba Jimba Calcarenite, and Billidee Formation. Only a small outcrop of the *Nunnery Sandstone* (Konecki, Dickins & Quinlan, 1958) is exposed, south of the Wooramel River upstream from Seven-Mile Pool ; it lenses out from about 200 feet thick where it is overlapped by the One Gum Formation. It is equivalent to the *Moogooloo Sandstone* (Craig, 1950 ; Condon, 1962a), which crops out in the Winnemia ridge (400 feet thick), in Pells Range (175 feet), east of Winderie, and between Arthur and Wyndham Rivers in the north-east corner of the Sheet (50 to 80 feet).

The *Jimba Jimba Calcarenite* (new name) is defined as the formation of fossiliferous calcarenite with minor calcilutite and sandstone conformably between the Moogooloo Sandstone below and the Billidee Formation above. The name is taken from Jimba Jimba Station, where it crops out ; the type locality is in the Winnemia Ridge 10 miles west of Jimba Jimba Homestead. The type section is 200 feet thick. Fossils include brachiopods, bryozoa, and crinoid ossicles. By reference to its position above the Callytharra, it is Artinskian in age. The only other known occurrence of a calcarenite formation in this stratigraphic position in the Carnarvon Basin is in Bore BMR 8, Mount Madeline. The Jimba Jimba Calcarenite is equivalent to the basal siltstone of the Billidee and One Gum Formations.

The *One Gum Formation* (Konecki, Dickins, & Quinlan, 1958) crops out only in the area south of the Wooramel River, 2 to 4 miles south-east of Seven Mile Pool ; it is about 285 feet thick, consisting of pebbly quartzwacke and sandstone with siltstone members. It contains a few marine fossils in the basal siltstone and plant fossils higher in the sequence. At the west end of the outcrop it overlaps the Nunnery Formation to rest unconformably on the Lyons Group. It is the equivalent of the lower part of the Billidee Formation.

The *Billidee Formation* (Condon, 1962a) crops out between the Arthur and Wyndham Rivers in the north-east where it is 230 feet thick ; in Pells Range (about 250 feet) ; at K-36 hill (135 feet) ; and three miles south of K-39 (210 feet). It consists of fine, medium, and coarse-grained quartzwacke and members of siltstone. It contains fossil wood and rare marine fossils. It is equivalent to the One Gum and Keogh Formations.

The *Keogh Formation* (Konecki, Dickins, & Quinlan, 1958) crops out only in a small area at the Sheet margin south of the Wooramel River. The full thickness is not exposed, as it is unconformably overlain by the Pindilya Formation.

The *Byro Group* (Condit, 1936 ; Raggatt, 1936 ; Condon, 1954, 1962a) consists in the Wooramel Sheet area of Coyrie Formation, Mallens Greywacke, and Bulgadoo Shale (comprising the Newman Sub-group ; Condon, 1962a), and Cundlego Formation and Wandagee Formation of the Minilya Sub-group (Condon, 1962a).

The *Coyrie Formation* (Condon, 1954, 1962a) consists of siltstone and fine-grained quartzwacke, with marine and plant fossils ; it crops out in the north-eastern corner of the Sheet (700 feet thick) ; north-west of Pells Range (600 feet) ; and in several small areas between Jacobs Gully and Doolwaddah Hill. It is conformable between the Billidee Formation below and the Mallens Greywacke above.

The *Mallens Greywacke* (Condon, 1954) consists of quartzwacke with marine fossils. It crops out four miles north-east of Bidgemia (600 feet thick) ; between the Arthur and Wyndham Rivers ; eight miles south of Bidgemia (600 feet) ; and seven miles south-south-west of Gascoyne Junction. It is conformable between the Coyrie Formation and Bulgadoo Shale.

The *Bulgadoo Shale* (Teichert, 1941 ; Condon, 1954, 1962a) consists of carbonaceous shale and siltstone with minor quartzwacke and evaporites ; it crops out 2½ miles north of Bidgemia (260 feet thick) and in an arcuate belt seven miles south-east, south, and south-west of Gascoyne Junction, where only the lower part of the formation is preserved with a thickness of 160 to less than 50 feet. The Bulgadoo Shale rests conformably on the Mallens Greywacke and is unconformably overlain by the Cundlego Formation ; this unconformity is well shown on the map south-west of Gascoyne Junction, although the relationship has not been observed in outcrop.

The *Cundlego Formation* (Teichert, 1941 ; Condon, 1954, 1962a) consists of laminated and festoon-bedded fine-grained quartzwacke and siltstone with marine fossils. It crops out north-west of Bidgemia, in the Gascoyne River from Gascoyne Junction downstream for 11 miles and south from the river for 5 miles ; in this area it is about 1650 feet thick and has many fossiliferous beds, including beds near the top with *Jimbacrinus*. It is unconformable on the Bulgadoo Shale and is overlain conformably by the Wandagee Formation. In this area, the upper part of the Cundlego Formation is equivalent to the Quinnanie Shale of the Minilya River area.

The *Wandagee Formation* (Teichert, 1941 ; Condon, 1954) consists of calcareous fine-grained quartzwacke and siltstone with many rich fossil beds. It crops out north of the Gascoyne River 6 to 13 miles westward from Gascoyne Junction, and along Salt Gully 9 to 12 miles westward from Gascoyne Junction. No complete sequence of the formation is developed on this Sheet. It is the uppermost Permian formation exposed on the Wooramel Sheet.

JURASSIC

The *Woodleigh Beds* (McWhae et al., 1958, p. 142) are soft grey shale with pyrite, containing lower Jurassic spores and pollens, found in bores on Woodleigh Station immediately south of the Wooramel Sheet. It is likely that this sequence extends onto the Wooramel Sheet area, but it has not been recognized in bores there.

CRETACEOUS

The Lower Cretaceous *Winning Group* (Raggatt, 1936 ; Condon, 1954 ; Johnstone, Condon, & Playford, 1958) crops out only in a few areas on the Sheet, but the meagre bore-records indicate that the complete sequence of the group is present at depth. It is not clear whether the sequence is more like the northern

(Condon, 1954) or the southern (Johnstone et al., 1958) sequence, but it certainly includes the Birdrong Formation and the Windalia Radiolarite ; and the Gearle Siltstone is almost certainly represented.

The *Birdrong Formation* (Condon, 1954) consists of quartz sandstone, quartzwacke, and siltstone, with glauconite ; it crops out, strongly lateritized, in the sides of the Wooramel River gorge below Meedo Pool. It is the main artesian aquifer of the western part of the Sheet. The evidence for the age of the Birdrong is weak, but suggests Lower Cretaceous (perhaps Neocomian).

The *Windalia Radiolarite* (Condon, 1954 ; Condon, Johnstone, Prichard, & Johnstone, 1956) consists of thin-bedded and laminated radiolarite with minor greensand. It crops out between Jacobs Gully and the north-east corner of Pimbie station. It is 150 feet thick in No. 18 Bore, Yaringa North (Johnstone & Playford, 1955). As the Windalia Radiolarite can be traced in outcrop from its type locality to Pimbie Station the Thirindine Formation (Johnstone, Condon, & Playford, 1958) of the Murchison River area is almost certainly part of the Windalia Radiolarite.

The *Gearle Siltstone* (Condon et al., 1956) consists of bentonitic siltstone and shale with minor radiolarite, greensand, and barite sand (in outcrop farther north). There is no outcrop on the Wooramel Sheet, but it is well known (as 'blackjack') to the water-bore drillers. It is 80 feet thick in No. 18 Bore, Yaringa North Station (Johnstone & Playford, 1955).

The Upper Cretaceous *Toolonga Calcilutite* (Johnstone et al., 1958) consists of fossiliferous calcilutite and chalk. It crops out in the scarps north and south of Yaringa North Homestead, where it is overlain unconformably by Miocene Trealla Limestone. In No. 18 Bore, Yaringa North, it is 240 feet thick and overlain by Eocene Giralia Calcarenite.

TERTIARY

Eocene

The middle Eocene *Giralia Calcarenite* (Condon et al., 1956) consists of hard yellow-green glauconitic calcarenite with abundant foraminifera (including *Asterocyclina* and *Discocyclina*) bryozoa, echinoids, pectenids, and brachiopods. It is 20 feet thick in No. 18 Bore, Yaringa North Station.

The *Pindilya Formation* (Konecki, Dickins, & Quinlan, 1958) probably of Eocene age, crops out in the top of the southern scarp of the Wooramel River gorge east of Seven Mile Pool ; it probably extends much farther west, but has not been identified. It also probably extends under much of the area of aeolian sand south and north of Wooramel River west of Callytharra, and probably grades laterally into the Merlinleigh Sandstone in the area west of Carey Downs Homestead. It is generally less than 50 feet thick and unconformably overlies the Permian formations.

The middle Eocene *Merlinleigh Sandstone* (Teichert 1950) crops out at the top of the scarps 8 to 15 miles north of Carey Downs Homestead ; it consists of fine-grained quartz sandstone with small quartz pebbles and minor thin quartz conglomerate beds. Maximum exposed thickness is 10 feet. The sandstone is duricrusted with a hard upper layer of siliceous billy. The Merlinleigh Sandstone is probably the parent rock of the lateritic soil from which is derived the aeolian sand of the area between Carey Downs, Ellavalla, and Meedo. It probably grades laterally into the Giralia Calcarene near the Wooramel River west of Meedo. It unconformably overlies the Permian Lyons Group north of Carey Downs and probably the Cretaceous formations under the sand plain area.

Miocene

The lower Miocene *Trealla Limestone* (Condon, Johnstone, & Perry, 1953) caps mesas and scarps near Yaringa North Homestead. It is hard white or light grey calcilutite with molluscs and numerous foraminifera. The maximum thickness is 25 feet. It unconformably overlies a duricrusted surface of the Cretaceous Toolonga Calcilutite ; it has not been observed in contact with the Giralia Calcarene, but the map relationship and nearly equivalent thickness suggest that the Trealla abuts against an erosion scarp in the Giralia.

Upper Tertiary

A deeply weathered zone up to 200 feet is preserved over most of the area except the dissected surface in the north-east. This is referred to in the map as *laterite* (the weathered profile up to and including the upper ferruginous zone), *billy* (the upper siliceous zone above or in the place of the ferruginous zone), and *lateritic soil* (the uppermost zone of the weathered profile, above the ferruginous zone or billy). This weathering developed after the lower Miocene (as the surface of the Trealla Limestone is duricrusted). It is likely that the deep weathering developed under conditions of climatic stability with a humid climate. In the global sense the time of development of climatic instability was the start of the Pleistocene ice age. For this reason, the age of the maximum development of the deep weathered profile is considered to be upper Tertiary.

QUATERNARY

Pleistocene

Small outcrops of the *Nadarra Formation* (Condon, 1962a) have been reported north-east of Yalbalgo Homestead ; no thickness is measured. This sequence of lacustrine limestone and chalcedonic chert was considered to be of Tertiary age, related to the process of lateritization ; but as it is deposited on the surface of the lateritic material it is more likely to be younger than the laterite and therefore to be of Quaternary age ; because in other areas (Glenburgh and Minilya Sheets) it is dissected, it is probably of Pleistocene age.

The *aeolian sand* is fine to medium-grained red quartz sand in seif dunes. The sand was derived directly from the upper part of a lateritic profile developed in Eocene sandstone. The sand appears to have moved only a short distance into the dunes, mainly from the interdune area adjacent. The dunes were formed during a very arid period or periods, probably during arid stages of the Pleistocene ice age.

The *Joolabroo Formation* (Condon, 1954) covers fairly large areas on either side of the Gascoyne River ; it is an old high-level alluvial deposit formed after the main dissection in the north-east part of the Sheet and itself dissected by the river and minor drainage. It is most probably Pleistocene in age, but younger than the Nadarra Formation. There are deposits of material equivalent to the Joolabroo Formation in the gorge of the Wooramel River and Nyarra Creek, too narrow to be shown on the map.

Pleistocene *marine sediments* consisting of fossiliferous sands, coquinite, and clay occupy a strip from the present coast inland from 1 to 4 miles. They reach about 15 feet above high water mark, and continue out under the water of Shark Bay.

Recent

Alluvium is deposited along the Gascoyne and Wooramel Rivers ; the surface of the alluvial delta of the Wooramel River is of Recent age, but the alluvial sequence probably extends down into the Pleistocene.

Wash, a veneer of sand and gravel, has been mapped only in a few areas, but small deposits of wash are characteristic of the outcrop plain of the north-east.

Sand has been mapped separately from the alluvium and wash in a few areas ; it is light brown or pale yellow-brown quartz sand, either alluvial or residual, but generally not thicker than about 10 feet.

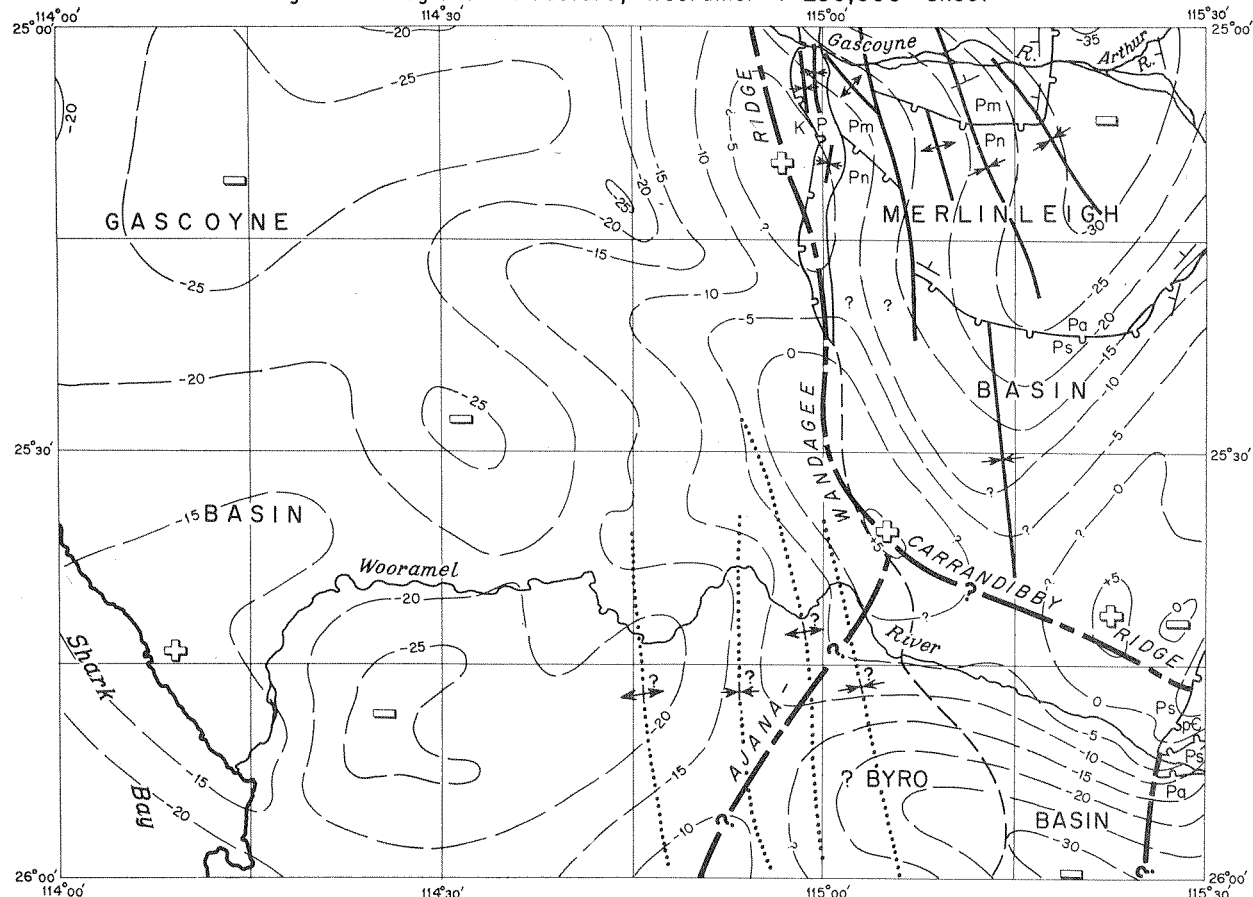
The *travertine* mapped in the Yalbalgo area may be older than Recent ; some of it may even be part of the Tertiary duricrust.

STRUCTURE

The regional structure of the Sheet area is shown in Figure 1, which also shows the Bouguer gravity anomalies (adapted from B.M.R. G.G., 1961).

The Ajana-Wandagee Ridge is a ridge of structurally high basement ; the gravity anomalies suggest that either there is very little sedimentary cover over this ridge or the rocks of the basement ridge are very dense. As the rocks of the basement ridge are known to be dense where it crops out at Ajana and as the magnetic anomalies indicate moderately thick sedimentary cover it is likely that the gravity anomalies relate to a dense basement rock.

Fig. 1 Regional structure, Wooramel 1:250,000 Sheet



- Basement Ridge
- Fault (inferred)
- ↑ Anticline, dotted where inferred
- ↓ Syncline, dotted where inferred

Unconformity

K/P: Cretaceous-Permian
Pm/Pn: Minilya-Newman
Pa/Ps: Artinskian-Sakmarian
P/pC: Permian-Precambrian

Regional dip
-25 Bouguer Anomaly contours - contour interval 5 milligals. Adapted from B.M.R. map No. G 69-432

The Ajana–Wandagee Ridge separates the western Gascoyne Basin from the eastern Merlinleigh Basin (Condon, 1956). The gravity anomalies indicate a spur ridge joining the Ajana–Wandagee Ridge to the Carrandibby Inlier. This has been called the Carrandibby Ridge, and separates the south end of the Merlinleigh Basin from another basin, possibly an extension of the Byro Basin.

The Gascoyne Basin contains lower Palaeozoic, upper Palaeozoic, Jurassic, Cretaceous, and Cainozoic sediments, and they may all be present in the subsurface of the Wooramel Sheet area. The Bouguer anomaly appears to reflect the structure of the Palaeozoic sediments : apparently a broad syncline, the axis of which runs from between Callagiddy and Ellavalla Homesteads south-south-west past Meedo Homestead. The Mesozoic–Cainozoic sediments appear to be mainly monoclinal, dipping gently westward.

The Merlinleigh Basin contains Devonian, Carboniferous, and Permian sediments mainly, with a minor overlap of Cretaceous and Eocene sediments. The Upper Palaeozoic sediments form a north-plunging regional syncline with minor anticlinal folds.

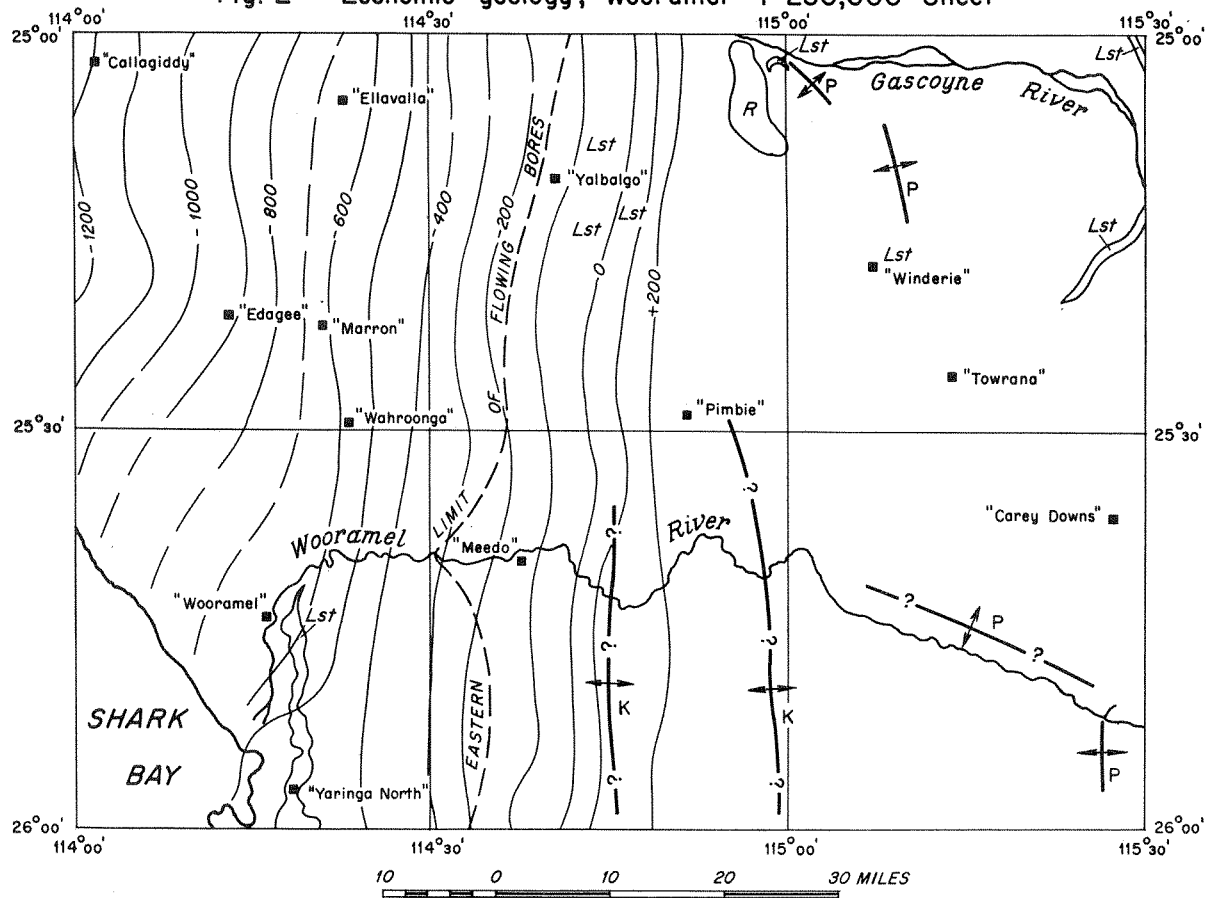
The Byro Basin contains Proterozoic, or lower Palaeozoic, and Permian sediments with a minor overlap of Cretaceous and Eocene sediments. The Permian sediments form a draped anticline plunging south off the south-west end of the Carrandibby Inlier, and indefinite trends in the lateritic soil south of the Wooramel River suggest synclines and anticlines that may have caused the major bends in the course of the Wooramel River between Meedo Pool and Meedo Homestead ; these folds, if they exist, would be developed in the Cretaceous sediments.

Because the gravity data are incomplete it is not possible to locate the basement ridges south of the Wooramel River accurately. Incomplete aeromagnetic data on the Byro and Yaringa Sheets suggest that the main basement ridge may continue south-south-west from the south-western end of the Carrandibby Inlier, in which case the area south of the Carrandibby Ridge would be part of the Gascoyne Basin. There is some possibility also that the Yallalong Ridge may extend northward to meet the Carrandibby Ridge, in which case the area of the Wooramel Sheet south of the Carrandibby Ridge may be the northern part of the Coolcalalaya Basin.

ECONOMIC GEOLOGY

The Sheet area has been little developed ; the only industries are wool-growing and fishing. Therefore the economic geology apart from water can be discussed only in terms of possibilities.

Fig. 2 Economic geology, Wooramel 1:250,000 Sheet



Water : There is very little permanent surface water except in a few pools in the Gascoyne and Wooramel Rivers. Shallow underground water is obtainable in the bed sand and alluvium of both rivers and in some areas of the lateritic surface ; insufficient data are available to establish the shape of the water table in the sand plain. Deeper confined water is present in the Cretaceous Birdrong Formation. The intake area is at the eastern margin of the Cretaceous sediments and particularly in the valleys of the Gascoyne and Wooramel Rivers. The water from this aquifer becomes artesian west of a line roughly from Yalbalgo to Meedo. Figure 2 shows the approximate contours on the top of the Birdrong aquifer.

East of the area of Cretaceous sediments the main aquifers are the sandstone member of the Weedarra Shale, the Moogooloo Sandstone, and the Mallens Greywacke. These are confined to the area north of the latitude of Winderie Homestead. Good supplies of potable water are available in the Moogooloo Sandstone and the sandstone member of the Weedarra Shale, and good to fair supplies of stock water from the Mallens Greywacke.

Petroleum : The Lyons Group, the Artinskian sequence, and the Cretaceous sequence contain potential source beds and reservoir beds for petroleum. Devonian source and reservoir rocks, established in Pelican Hill Bore, 10 miles north of Carnarvon, almost certainly extend at least into the north-western part of the Sheet area. The Silurian carbonates in Dirk Hartog bore probably extend eastward into the Sheet area (see section CD) and could include or change into source and reservoir rock types.

Fold structures are suggested by faint trends in the eastern part of the Cretaceous area south of the Wooramel River. These would provide traps on the general west-dipping homocline and if sufficiently steep on the west flank would prevent flushing by the flow of meteoric water. Seismic surveys would be required to establish the reality and structural form of these folds. Only minor anticlinal folds are indicated in the outcrop area of the Lyons Group, but it is very likely that major anticlines, perhaps as draped folds, overlie the basement ridges. The gravity high at Pimbie may coincide with a high area of the basement ridge, and this may be overlain by a closed anticline in the Lyons Group. Drilling in the Byro Basin indicated marine shales and limestones and permeable sands in the Lyons Group (Mercer, 1959, unpubl.). Devonian marine shale and sandstone almost certainly extend into the north-western part of the Sheet area, and may extend across the Ajana-Wandagee Ridge into the Merlinleigh Basin (section A-B). If they do they are likely to be anticlinal across the ridge and to offer targets for drilling for oil. The Silurian sediments probably extend across the Gascoyne Basin, but possibly wedge out on the western side of the Ajana-Wandagee Ridge. They may have drained oil into basal Devonian Sands.

Other Materials

Limestone for road aggregate and possibly for lime and portland cement manufacture could be quarried in the Winnemia Ridge and in Pells Range. Friable limestone for lime or cement could be carried from the travertinized Upper Cretaceous chalk near Yalbalgo and in the scarps around Yaringa North Homestead.

Shale for brick manufacture and for inclusion in portland cement manufacture is probably available in the Weedarra Shale outcrop area south of Gascoyne Junction, and in the Gearle Siltstone area (not outcropping) between Bibras Well, Winderie, and Wollarrie Pool on the Wooramel River. The leached surface of the Gearle Siltstone, which may be more than 100 feet deep, should be suitable for pale bricks, and some of it may be refractory.

Radiolarite for use as fillers, filter medium, and fine abrasive could be quarried in the area between Salt Gully and Boolardy Well, Jimba Jimba Station.

Evaporite Salts may be present in the Bulgadoo Shale south of Gascoyne Junction, below the water table. This has yet to be proved by drilling, but some strong brines have been encountered in drilling for water.

Laterite under the red sand of the sand plain is a widespread source of road aggregate. The laterite has not been examined, but where it is developed in the Cretaceous shale, as probably in the area south of Wollarrie Pool, Wooramel River, bauxite may possibly have been formed.

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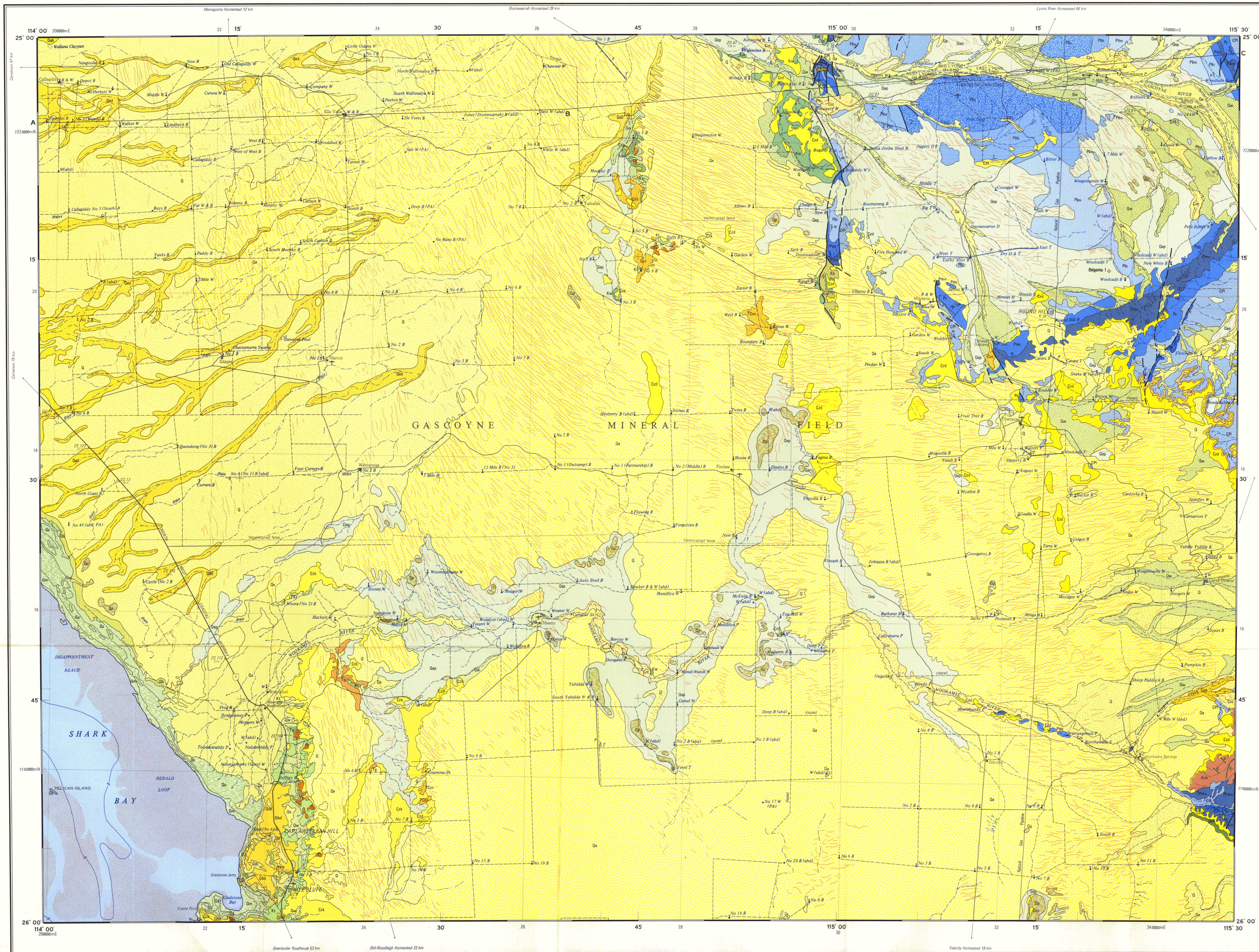
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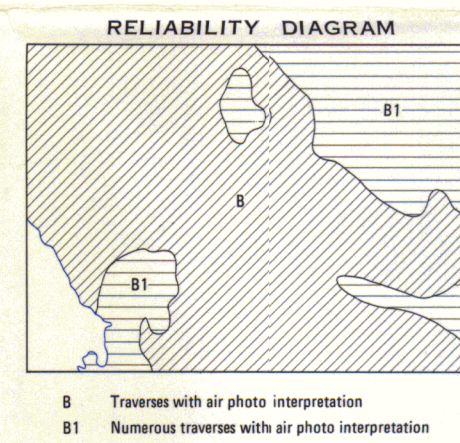
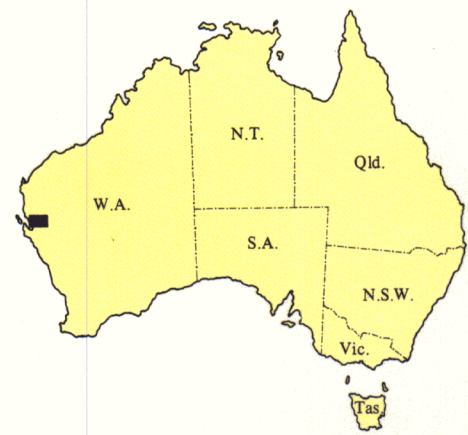
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SCALE 1:250 000

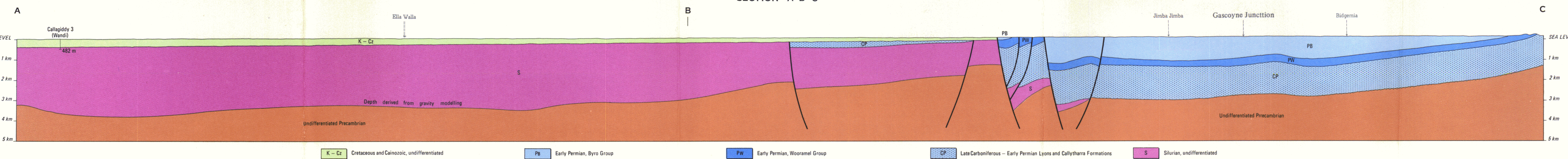
TRANSVERSE MERCATOR PROJECTION

ZONE 50 AUSTRALIAN MAP GRID

DIAGRAMMATIC SECTION

SCALE 1:2

SECTION A-B-C



K-Gi Cretaceous and Cenozoic, undifferentiated

Pn Early Permian, Byro Group

Pw Early Permian, Wooramel Group

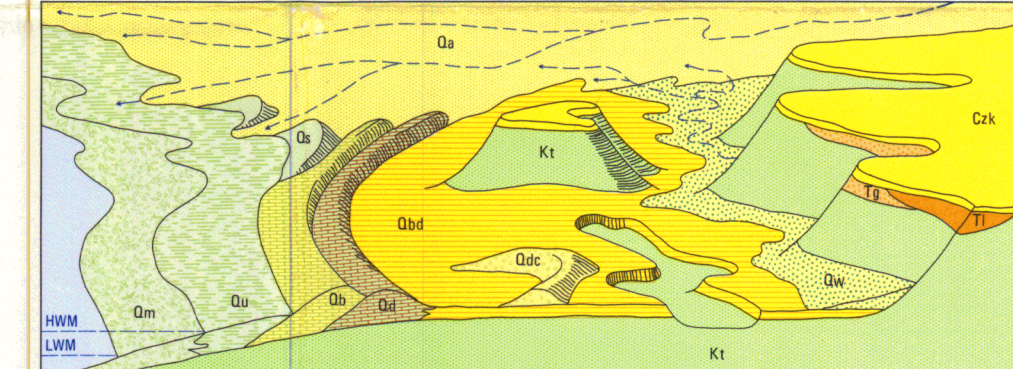
Lp Late Carboniferous - Early Permian Lyons and Callihya Formations

S Silurian, undifferentiated

REFERENCE

- Qn Tuffite deposits - shelly limestone, sand, gravel; extensively covered by silt and clay.
Qa Supracrustal rocks - shelly limestone, sand, gravel; minor xenolithic gneiss and silt.
Qb Beach, beach ridge and coastal dune deposits - calcarenite, locally contains corals and shells. *Protopora erugata* shells.
- Q Deposits of mixed or igneous origin - alluvial, colluvial, alluvial and silt, silt, sand and gravel; commonly in older alluvial and alluvial deposits partially mantled by silt and gravel.
Qa Alluvium - clay, silt, sand and gravel; locally calcareous, associated with drainage lines.
Qb Dinosaur and alluvium - clay, silt, sand and gravel; locally calcareous, no well defined drainage pattern.
Qc Sandplain and dune deposits - reddish brown to yellowish calcareous sand, includes intertidal deposits.
Qd Pebbly and dune deposits - alluvial, alluvial and silt, silt, sand and gravel; mixed dune and plays terrain, commonly associated with major palaeochannels.
Qe Crayons and silt lake deposits - clay, silt, sand and gravel in larger claypans and coastal saline lakes.
- Qb BIRLA LIMESTONE: shelly calcarenite to calcarenite; shallow marine and beach ridge deposits; minor calcarenite.
Qc Cretaceous Member: calcareous calcarenite, coastal dune and T shallow marine deposits; extensively calcareous; forms low ridges.
Qd DAMPER LIMESTONE: shelly calcarenite to calcarenite; shallow marine and beach ridge deposits; extensively calcareous.
Qe Undifferentiated; commonly obscured by this alluvial layer.
- Qa Alluvium - deposits of Brown Channel, Gascoyne River; poorly sorted silt, sand, gravel and clay; partly calcareous.
Qb Sandplains marking sheet drainage lines of Gascoyne River; predominate Brown Channel.
Qc Older alluvium - yellowish to grey brown coarse sandstone, claystones and siltstones.
- Qa Calcareous - nodular, platy and laminated well-indurated argillaceous limestone duricrust; includes minor gneiss in Gascoyne Junction area.
Qb NADARRA FORMATION: micritic limestone and calcareous mudstone, localities.
Qc Older alluvium, calcareous and alluvial deposits - consolidated clay, silt, sand and gravel.
- Ti LAMONT SANDSTONE: fine to very coarse grained siliceous quartz arenite; generally moderately sorted; shallow marine.
Tj PINDILYA FORMATION: medium grained to pebbly, poorly sorted sandstone and sandy siltstone; Talarium, mostly siliceous.
- Qa Farnborough and alluvium dolerite - basaltic, shaly, some intensely farnborough and/or siliceous bedrock.
- Ta BIRLA CALCARENITE: glauconitic, bioturbated limestone; greenish to brownish clay, locally quartzite; shallow marine.
- Ki TOOLONGA CALCULITE: marly, greenish and white calcarenite, minor chert; commonly poorly exposed; low energy marine shelf.
- Ka WINDALLA RADIOLARITE: radiolarian siltstone; variably porcellaneous, locally varicoloured; low energy marine shelf.
- Kb BIRROD SANDSTONE: medium grained coarse sandstone; moderately sorted, commonly farnborough; high energy shallow marine.
- Pn NADARRA FORMATION: argillaceous and fine quartz wacke; bioturbated and fossiliferous; offshore and shallow marine.
Pw WANDAGE FORMATION: argillaceous and fine quartz wacke; bioturbated and fossiliferous; offshore and shallow marine.
Pc CUNDLEGO FORMATION: quartz wacke, siltstone and shale; locally fossiliferous; shallow marine; commonly extensive in ridges of calcarenite, well-indurated quartz wacke.
Pb BULLGODD SHALE: shale, siltstone, minor quartz wacke; variably calcareous, fossiliferous; offshore marine.
Pn MALLERIE SANDSTONE: quartz wacke, minor quartz arenite; bioturbated and cross-bedded; offshore and shallow marine.
Pc COYNE FORMATION: siltstone, claystone, quartz wacke; commonly thin-bedded; offshore and shallow marine.
Pn BILLIDES FORMATION (Pn1): pelagophytic and quartz wacke, siltstone; commonly thin-bedded; shallow marine.
Pn1 NADARRA FORMATION (Pn1): fossiliferous calcarenite and hard fossiliferous calcarenite; shallow marine with calcarenite shales.
Pn2 KESPEL FORMATION (Pn2): siltstone, sandstone, minor claystone; poorly exposed; shallow marine to offshore.
Pw MODOGLOD SANDSTONE: quartz arenite; minor pebble conglomerate, quartz wacke, pelagophytic wacke and argillaceous; detrital and shallow marine with calcarenite shales.
Pc CALLITHYRA FORMATION: friable calcareous siltstone (lower), interbedded with hard calcarenite (upper); fossiliferous, shallow marine with calcarenite shales.
Pc CARRADIBY FORMATION: micaceous and calcareous siltstone, sandstone and claystone; fossiliferous, shallow marine, locally glauconitic.
Pc LYONS FORMATION: quartz wacke, shale, siltstone and siltite; contains numerous glacial erratic, continental and marine, glauconitic.
- Pd Dolerite dyke of variable Proterozoic age (may be weakly metamorphosed).
- Ana Banded microcline plagioclase-quartz biotite gneiss; coarse to fine grained; migmatitic in part.

ROCK RELATIONSHIPS GLADSTONE EMBAYMENT AREA



WOORAMEL

SHEET SG 50 - 5

SECOND EDITION 1985

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